

A Limited Comparison of Energy Costs in Wisconsin Dairy Systems

By Tom Kriegl¹
November 28, 2005

Energy Cost Comparison Summary

- 1.) You must read the whole report to fully understand it. There is much more information missing from this analysis than there is in it. Its best use is as a stimulator of discussion. **This analysis does not show which dairy system is most energy efficient.**
- 2.) Comparing the relative energy efficiency of different Wisconsin dairy systems is challenging. Anything short of a life cycle analysis may omit significant energy costs, such as the energy used to produce purchased grain. A disadvantage of a life cycle analysis is that it is difficult to do. It can be done with actual data only with extreme difficulty. Usually, it is done by modeling, which does require many assumptions. In this analysis, money spent on costs that have high energy content was used as the efficiency standard instead comparing energy efficiency using physical units such as calories or BTU's as the efficiency standard.
- 3.) In a comparison of the **four easily measured** energy cost categories per cwt of milk equivalent sold, differences in energy cost-efficiencies seem to appear. However, these **differences may be nullified by differences in the proportion of feed raised and custom work hired in the various systems.**
- 4.) It should surprise no one that the four easily measured energy costs have trended upward in absolute amounts slightly from 1995 to 2004 but stayed in a narrow range of percent of allocated costs. Increases from 2004 to 2005 will likely be much more dramatic.
- 5.) From 1995 to 2004, the four easily measured energy cost categories used about 8-11% of the total allocated costs on Wisconsin dairy farms. Total costs minus opportunity costs equals total allocated costs. **Since there is an energy input in most items, energy costs are likely to represent more than 8-11% of total allocated cost, suggesting that energy conservation in all systems could be more helpful to the financial bottom line than some may expect.**

Introduction

A number of events in the last several months and years have increased concerns about energy consumption. It is popularly believed that grazing operations are more energy efficient than confinement operations. To test that belief, ten years of actual farm financial data from nineteen to forty-three grazing dairy farms in the Wisconsin Grazing Dairy Profitability Analysis were compared with ten years of actual farm financial data from hundreds of "confinement" dairy farms from the Fox Valley and Lakeshore Farm Management Association data sets.

To compare the relative energy efficiency of the different dairy systems, one would have to perform a life cycle analysis. Life Cycle Assessment is a quantitative method to measure the energy and material flows associated with all stages of a product from cradle to grave². If we were to perform a life cycle energy analysis of a car, we would account for (1.) the energy to extract the compositional materials, (2.) the energy used in its manufacture, (3.) the energy used in its operation, and (4.) the energy used in its disposal. Such an analysis has not been done with the data in this comparison.

So while there is an energy input and cost in everything that is done, a less rigorous comparison of some energy expenses has been made in an attempt to gain some insight into energy efficiency. Four cost factors were considered at first. Two categories of expenses – utilities and gasoline, fuel and oil are clearly energy expenses. The two other expense categories are for items that have high-energy inputs, more specifically, chemicals and fertilizer/lime. These four expense categories only consider the most obvious costs associated with energy to crudely approximate the energy efficiency of different dairy systems.

¹ Center for Dairy Profitability, College of Agricultural and Life Sciences and Cooperative Extension, University of Wisconsin – Madison. Please see the Center's Website at <http://cdp.wisc.edu>.

² National Pollution Prevention Center for Higher Education. University of Michigan—Ann Arbor. Letter dated February 17, 1999.

In a second step, custom hire and purchased feed expenses were also compared. Partly because there is such a wide range in pounds of milk sold per cow among the Wisconsin dairy systems considered in this article, costs were compared only on a per hundredweight equivalent (CWT EQ) basis.

Data Source

Lakeshore Farm Management Association, Fox Valley Management Association, Wisconsin Farm and Business Management Association, Wisconsin County Agents, Wisconsin Technical College System Instructors, and Center for Dairy profitability staff originally collected this data. Collectors helped individual farm managers reconcile their financial data. Individual farm managers used a number of different manual and computerized record keeping systems to enter the initial financial records, including the Agricultural Accounting and Information Management System (AAIMS©) The computer program called Agricultural Financial Advisor (AgFA©) was used to analyze the data for this report.

Graziers vs. Confinement

When comparing the four easily measured energy costs as described above, graziers had lower energy costs per hundredweight equivalent of milk sold than confinement farms in all ten years. Unfortunately the number of observations of graziers is much smaller.

TABLE 1a Comparing Selected Energy Cost Items in dollars per hundredweight equivalent of milk sold by Graziers (G) and Confinement Farms (C)

	Farm Types	Number of Herds	Average Herd Size	Chemicals	Fertilizer and Lime	Gas	Utilities	Total of Estimated Energy Costs	Difference (G-C) Advantage to Graziers
2004	G	38	65	\$0.08	\$0.34	\$0.35	\$0.34	\$1.11	
	C*	661	134	\$0.20	\$0.35	\$0.34	\$0.31	\$1.20	(\$0.09)
2003	G	43	61	\$0.06	\$0.30	\$0.26	\$0.31	\$0.93	
	C	652	123	\$0.18	\$0.28	\$0.26	\$0.27	\$0.99	(\$0.06)
2002	G	31	61	\$0.05	\$0.20	\$0.20	\$0.30	\$0.75	
	C	581	117	\$0.17	\$0.23	\$0.23	\$0.27	\$0.90	(\$0.15)
2001	G	27	62	\$0.05	\$0.34	\$0.21	\$0.30	\$0.90	
	C	627	106	\$0.21	\$0.32	\$0.31	\$0.29	\$1.13	(\$0.23)
2000	G	28	65	\$0.05	\$0.35	\$0.20	\$0.27	\$0.87	
	C	605	109	\$0.17	\$0.26	\$0.28	\$0.25	\$0.96	(\$0.09)
1999	G	21	71	\$0.04	\$0.33	\$0.16	\$0.26	\$0.79	
	C	620	97	\$0.21	\$0.35	\$0.21	\$0.25	\$1.02	(\$0.23)
1998	G	19	63	\$0.04	\$0.36	\$0.16	\$0.26	\$0.82	
	C	780	99	\$0.26	\$0.45	\$0.23	\$0.25	\$1.19	(\$0.37)
1997	G	19	57	\$0.06	\$0.26	\$0.20	\$0.26	\$0.78	
	C	871	93	\$0.20	\$0.40	\$0.26	\$0.25	\$1.11	(\$0.33)
1996	G	19	56	\$0.06	\$0.37	\$0.20	\$0.28	\$0.91	
	C	978	83	\$0.21	\$0.49	\$0.30	\$0.28	\$1.28	(\$0.37)
1995	G	19	50	\$0.03	\$0.29	\$0.16	\$0.25	\$0.73	
	C	928	76	\$0.18	\$0.47	\$0.26	\$0.28	\$1.19	(\$0.46)

* Preliminary data

The average grazer had a slight advantage in the table 1a energy costs per hundredweight equivalent of milk sold categories in most years.

While not shown in table form in this report, these four “energy expenses,” use about 9-11% of total allocated costs for the confinement group and 8-11% for graziers.

Table 1b. Comparing Feed Purchased and Custom Hire Costs in dollars per hundredweight equivalent of milk sold by Graziers (G) and Confinement Farms (C).

	Farm Types	Number of Herds	Average Herd Size	Feed Purchased	Custom Hire	Feed Purchased plus Custom Hire Costs	Difference (G-C) Advantage to Graziers
2004	G	38	65	\$3.08	\$0.35	\$3.43	(\$0.41)
	C *	661	134	\$3.39	\$0.45	\$3.84	
2003	G	43	61	\$2.65	\$0.30	\$2.95	\$0.12
	C	652	123	\$2.44	\$0.39	\$2.83	
2002	G	31	61	\$2.59	\$0.36	\$2.95	\$0.19
	C	581	117	\$2.35	\$0.41	\$2.76	
2001	G	27	62	\$2.85	\$0.30	\$3.15	(\$0.02)
	C	627	106	\$2.71	\$0.46	\$3.17	
2000	G	28	65	\$2.32	\$0.26	\$2.58	\$0.06
	C	605	109	\$2.11	\$0.41	\$2.52	
1999	G	21	71	\$2.94	\$0.39	\$3.33	\$0.64
	C	620	97	\$2.30	\$0.39	\$2.69	
1998	G	19	63	\$3.25	\$0.33	\$3.58	\$0.45
	C	780	99	\$2.77	\$0.36	\$3.13	
1997	G	19	57	\$3.03	\$0.25	\$3.28	\$0.28
	C	871	93	\$2.76	\$0.24	\$3.00	
1996	G	19	56	\$3.47	\$0.27	\$3.74	\$0.73
	C	978	83	\$2.77	\$0.24	\$3.01	
1995	G	19	50	\$2.69	\$0.15	\$2.84	(\$0.13)
	C	928	76	\$2.76	\$0.21	\$2.97	

* Preliminary data

It's not totally clear how much of the grazier's energy cost per hundredweight equivalent of milk sold advantage is helped by the fact that **few of them raise grain**. Most of the graziers in the study do feed grain at levels that are probably slightly lower than confinement levels. If the energy cost of their purchased grain were accounted for, it would increase grazier's energy cost per hundredweight equivalent of milk sold by an amount undetermined in this analysis. Table 1a shows that graziers typically have a higher combined purchased feed and custom hire cost per hundredweight equivalent of milk sold compared to confinement herds.

Since most people agree that grazing operations should require less machinery, buildings, etc. than confinement systems, graziers may have an energy efficiency advantage for the extra factors included in a life cycle energy analysis comparison, but maybe not as much of an advantage as graziers expect.

Seasonal vs. Non-Seasonal

One advantage often claimed for seasonal calving/milking systems (all the cows dry simultaneously at least once each calendar year) is savings in a number of costs involved in operating a milking facility. Included in those costs are electricity and gas used to cool milk, heat water and facilities, etc. For example, it makes sense that processing a given volume of milk through milking facilities in 10 months should require less energy than processing the same milk volume in 12 months. Whether or not that assumption is true, the four easily measured energy costs were slightly higher for the average seasonal herd in six of ten years.

TABLE 2a Comparing Selected Energy Cost Items in dollars per hundredweight equivalent of milk sold by Seasonal (S) and Non-Seasonal Graziers (N)

	Farm Types	Number of Herds	Average Herd Size	Chemicals	Fertilizer and Lime	Gas	Utilities	Total of Estimated Energy Costs	Difference (S-N) Advantage to Seasonal
2004	S	4	79	\$0.00	\$0.40	\$0.31	\$0.29	\$1.00	(\$0.12)
	N	34	64	\$0.09	\$0.33	\$0.36	\$0.34	\$1.12	
2003	S	5	79	\$0.00	\$0.17	\$0.20	\$0.27	\$0.64	(\$0.34)
	N	38	59	\$0.06	\$0.33	\$0.27	\$0.32	\$0.98	
2002	S	3	79	\$0.00	\$0.20	\$0.21	\$0.34	\$0.75	\$0.01
	N	28	59	\$0.05	\$0.20	\$0.20	\$0.29	\$0.74	
2001	S	5	79	\$0.00	\$0.45	\$0.13	\$0.27	\$0.85	(\$0.07)
	N	22	58	\$0.06	\$0.31	\$0.24	\$0.31	\$0.92	
2000	S	4	81	\$0.06	\$0.43	\$0.09	\$0.24	\$0.82	(\$0.13)
	N	24	61	\$0.05	\$0.38	\$0.23	\$0.29	\$0.95	
1999	S	5	107	\$0.04	\$0.40	\$0.15	\$0.27	\$0.86	\$0.11
	N	16	60	\$0.04	\$0.30	\$0.16	\$0.25	\$0.75	
1998	S	4	64	\$0.04	\$0.48	\$0.14	\$0.29	\$0.95	\$0.16
	N	15	63	\$0.04	\$0.34	\$0.16	\$0.25	\$0.79	
1997	S	4	53	\$0.00	\$0.46	\$0.19	\$0.34	\$0.99	\$0.25
	N	15	58	\$0.07	\$0.22	\$0.21	\$0.24	\$0.74	
1996	S	4	52	\$0.00	\$0.57	\$0.19	\$0.36	\$1.12	\$0.25
	N	15	57	\$0.07	\$0.34	\$0.20	\$0.26	\$0.87	
1995	S	4	46	\$0.01	\$0.42	\$0.13	\$0.24	\$0.80	\$0.08
	N	15	51	\$0.03	\$0.26	\$0.17	\$0.26	\$0.72	

In nine of ten years, the combined cost of purchased feed and custom hire per CWT EQ for seasonal herds exceeded that of non-seasonal herds. This makes it unlikely that the seasonal grazing system is more energy efficient than the non-seasonal grazing system. Along with the slight disadvantage seasonal herds had in table 2a, this indicates that the seasonal grazing herds were less energy efficient than the non-seasonal grazing herds in this comparison.

Table 2b Comparing Feed Purchased and Custom Hire Costs in dollars per hundredweight equivalent of milk sold by Seasonal (S) and NON-Seasonal Graziers (N)

	Farm Types	Number of Herds	Average Herd Size	Feed Purchased	Custom Hire	Feed Purchased plus Custom Hire Costs	Difference (S-N) Advantage to Non-Seasonal
2004	S	4	79	\$3.45	\$0.15	\$3.60	\$0.50
	N	34	64	\$3.03	\$0.07	\$3.10	
2003	S	5	79	\$3.51	\$0.28	\$3.79	\$1.28
	N	38	59	\$2.50	\$0.01	\$2.51	
2002	S	3	79	\$3.93	\$0.43	\$4.36	\$1.90
	N	28	59	\$2.46	\$0.00	\$2.46	
2001	S	5	79	\$3.51	\$0.28	\$3.79	\$0.84
	N	22	58	\$2.65	\$0.30	\$2.95	
2000	S	4	81	\$2.67	\$0.22	\$2.89	\$0.13
	N	24	61	\$2.48	\$0.28	\$2.76	
1999	S	5	107	\$3.26	\$0.19	\$3.45	\$0.42
	N	16	60	\$2.80	\$0.23	\$3.03	
1998	S	4	64	\$3.36*	\$0.53	\$3.89	\$1.35
	N	15	63	\$2.25	\$0.29	\$2.54	
1997	S	4	53	\$3.36*	\$0.29	\$3.65	\$0.42
	N	15	58	\$2.98	\$0.25	\$3.23	
1996	S	4	52	\$3.22	\$0.44	\$3.66	(\$0.10)
	N	15	57	\$3.51	\$0.25	\$3.76	
1995	S	4	46	\$2.89	\$0.06	\$2.95	\$0.12
	N	15	51	\$2.66	\$0.17	\$2.83	

*by coincidence, these numbers are the same

Traditional Confinement vs. Large, Modern Confinement

The annual Center for Dairy Profitability (CDP) report on Milk Production Costs for selected Wisconsin Dairy Farms sorts farms into six size categories. These categories include 50 cows or less, 51 to 75 cows, 76 to 100 cows, 101 to 150 cows, 151 to 250 cows and more than 250 cows.

The 51 to 75 cow category typically has more farms and higher NFIFO/cow and per CWT EQ than the other size groups. The average herd size in Wisconsin has been between 51 and 75 cows in this ten year period. Therefore the data from this size group is used to represent the traditional confinement (TC) dairy farms of Wisconsin. The over 250 cow herd size category is used to represent the large modern confinement (LMC) herds in Wisconsin in table 3.

While not shown in table form in this report, a comparison of these four easily measured energy costs use about 10-13% of total allocated costs for the TC group and 5.5-6.5% for the LMC group.

When the confinement herds are separated into traditional confinement and large modern confinement (LMC) groups, the four easily measured energy costs of the TC herds are substantially higher than any other group (see Table 3a).

The LMC herds are almost at the other extreme. Only the non-seasonal grazing group has lower selected energy costs (see Table 2). Just as confinement herds tend to raise a higher percent of the grain they feed when compared to graziers, TC herds may raise a higher percent of the grain they feed when compared to LMC herds. In fact, the TC herds advantage in purchased feed costs per CWT EQ is larger than their selected energy cost disadvantage when compared to the LMC herds. Therefore, it appears that much of the energy efficiency advantage that appears in table 3a for the LMC over the TC herds could be explained by feed sources (see table 3b).

TABLE 3a Comparing Energy Cost in dollars per hundredweight equivalent of milk sold by Traditional Confinement (TC) with 50-75 cows and Large, Modern Confinement (LMC) with 250+ cows

	Farm Types	Number of Herds	Average Herd Size	Chemicals	Fertilizer and Lime	Gas	Utilities	Total of Estimated Energy Costs	Difference (LMR-TC) Advantage to Large Modern Confinement
2004	TC	203	63	\$0.29	\$0.47	\$0.39	\$0.39	\$1.54	(\$0.65)
	LMC	80	519	\$0.17	\$0.20	\$0.29	\$0.23	\$0.89	
2003	TC	204	63	\$0.26	\$0.43	\$0.29	\$0.33	\$1.31	(\$0.59)
	LMC	67	482	\$0.14	\$0.16	\$0.21	\$0.21	\$0.72	
2002	TC	180	63	\$0.21	\$0.34	\$0.26	\$0.34	\$1.15	(\$0.50)
	LMC	57	454	\$0.13	\$0.12	\$0.19	\$0.21	\$0.65	
2001	TC	200	63	\$0.24	\$0.42	\$0.35	\$0.35	\$1.36	(\$0.52)
	LMC	46	442	\$0.15	\$0.21	\$0.26	\$0.22	\$0.84	
2000	TC	196	63	\$0.21	\$0.36	\$0.32	\$0.29	\$1.18	(\$0.49)
	LMC	47	467	\$0.12	\$0.13	\$0.25	\$0.19	\$0.69	
1999	TC	216	62	\$0.23	\$0.43	\$0.23	\$0.28	\$1.17	(\$0.41)
	LMC	34	443	\$0.18	\$0.21	\$0.18	\$0.19	\$0.76	
1998	TC	266	62	\$0.27	\$0.56	\$0.26	\$0.30	\$1.39	(\$0.49)
	LMC	50	451	\$0.23	\$0.29	\$0.19	\$0.19	\$0.90	
1997	TC	316	62	\$0.23	\$0.44	\$0.27	\$0.27	\$1.21	(\$0.40)
	LMC	42	457	\$0.15	\$0.24	\$0.23	\$0.19	\$0.81	

When comparing all six herd size categories in the eight years they have been sorted, an interesting pattern occurs. The combined four selected energy costs per CWT EQ tends to decline as herd size increases. One exception is that the smallest size category tends to have lower selected energy costs than the next two larger herd sizes.

There is an opposite pattern for purchased feed and custom hire expense. In other words, as herd size decreased, the per CWT EQ cost of purchased feed and custom hire expenses decrease until the smallest herd size in which these costs tend to be higher than for the 51 to 75 and 76 to 100 cow sizes but lower than for the larger herd sizes.

So once again the advantage in the four easily measured energy cost categories that increase with herd size appear to be nullified by their disadvantage in purchased feed and custom hire costs.

Table 3b Comparing Feed Purchased and Custom Hire costs in dollars per hundredweight equivalent of milk sold by Traditional Confinement (TC) with 50-75 cows and Large, Modern Confinement (LMC) with 250+ cows.

	Farm Types	Number of Herds	Average Herd Size	Feed Purchased	Custom Hire	Feed Purchased plus Custom Hire Costs	Difference (LMR-TC) Advantage to Large Modern Confinement
2004	TC	203	63	\$1.88	\$0.35	\$2.23	\$1.15
	LMC	80	519	\$2.93	\$0.45	\$3.38	
2003	TC	204	63	\$1.88	\$0.35	\$2.23	\$1.15
	LMC	67	482	\$2.93	\$0.45	\$3.38	
2002	TC	180	63	\$2.00	\$0.36	\$2.36	\$0.86
	LMC	57	454	\$2.76	\$0.46	\$3.22	
2001	TC	200	63	\$2.27	\$0.36	\$2.63	\$1.17
	LMC	46	442	\$3.27	\$0.53	\$3.80	
2000	TC	196	63	\$1.73	\$0.28	\$2.01	\$1.03
	LMC	47	467	\$2.55	\$0.49	\$3.04	
1999	TC	216	62	\$1.96	\$0.32	\$2.28	\$0.93
	LMC	34	443	\$2.80	\$0.41	\$3.21	
1998	TC	266	62	\$2.31	\$0.30	\$2.61	\$1.24
	LMC	50	451	\$3.48	\$0.37	\$3.85	
1997	TC	316	62	\$2.42	\$0.23	\$2.65	\$1.00
	LMC	42	457	\$3.44	\$0.21	\$3.65	

Organic vs. Other Dairy Systems

Actual farm financial data from organic farms remains scarce. An examination of the small amount of organic data suggests that it is subject to the same kinds of hurdles to comprehensive energy efficiency comparisons as described in the above comparisons.